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Understanding Humour in the Cognitive Resource Structure of Academically Successful Students

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Abstract: The objective of this research was to identify the specific characteristics of humour comprehension that differentiate academically successful students from their less successful counterparts, and to establish the relationship between humour comprehension and other variables within the structure of cognitive resources. A total of 325 students from various higher education institutions, representing a range of academic achievement levels, participated in the study. The research design employed a mixed-methods approach, incorporating both qualitative and quantitative methods for data processing and interpretation. The interrelationship between humour comprehension and cognitive variables was examined using factor analysis, whilst the statistical significance of group differences was assessed via the Kruskal-Wallis H test, Fisher's φ* angular transformation, and Pearson's chi-squared (χ^2) test. The total variance explained in the factor models (79.64%, 81.02%, and 95%), alongside the significance levels observed (ranging from $p \leq 0.01$ to $p \leq 0.05$), reflects the reliability and significance of the findings. Factor analysis revealed strong, positive correlations between humour comprehension and cognitive characteristics across all groups; however, the structure of these relationships differed. In high-achieving students, rapid humour comprehension was associated with a reduced speed of idea generation, while a lower reliance on factual information contributed to higher-quality humour comprehension, reflecting a high level of comic recognition. In students with average academic achievement, the factor structure showed partial integration of metacognitive, creative, and intellectual characteristics, with signs of inconsistency; a compensatory mechanism was observed for deficits in humour comprehension. In low-achieving students a discrepancy was found between the potential for humour comprehension and its underutilisation.

Keywords: *academic success, cognitive resource, humour comprehension, emotional intelligence, creativity, metacognitive characteristics.*

Introduction

The relevance of studying academic achievement in higher education stems from its pivotal role in shaping competitive professionals. Approaches to enhancing achievement through the optimisation of cognitive resources are in demand in the context of training personnel capable of addressing complex, interdisciplinary challenges, as reflected in various studies (Goegan and Daniels, 2021). The dynamic evolution of technology and the labour market requires graduates to possess not only subject-matter expertise but also metacognitive skills, the ability to self-regulate learning, and critical thinking, ensuring adaptation to changing circumstances. Consideration of students' individual cognitive profiles (for instance, through the lens of cognitive styles or abilities) enables the development of personalised learning pathways, maximising their professional potential (Privado, Pérez-Eizaguirre, Martínez-Rodríguez and Ponce-de-León, 2024). Thus, analysing academic achievement in higher education through the prism of an individual's cognitive resources not only facilitates the identification of factors determining learning effectiveness, but also the development of evidence-based strategies for improving the quality of professional training and ensuring graduate competitiveness. The investigation of cognitive factors underpinning academic achievement can be significantly enhanced and enriched by incorporating an aspect such as humour comprehension into the analysis, demonstrating a potential link with cognitive development and

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intellectual flexibility. It should be noted that the use of humour in the educational process is of considerable importance (Nurcendani and Wijaya 2022; Neff and Rucynski, 2017; Bakar and Mallan, 2023), yet its relationship with educational success is ambiguous (Cadorna, 2021). This observed ambiguity in the connection between humour and academic achievement is likely mediated by students' cognitive capabilities, or more precisely, their ability to comprehend and perceive humorous expressions (Dvoynin and Trotskaya, 2022). This research problem currently remains under-explored. In other words, the question of how a sense of humour (its comprehension and recognition) relates to cognitive resources, and whether this relationship corresponds with academic achievement, remains open.

Theoretical analysis has revealed that academic achievement is a multifaceted concept, primarily comprising objective outcomes of academic activities and a student's subjective evaluation of their accomplishments, including the attainment of individual goals (Galatskova and Petrenko, 2020; Guterman, 2021). The multi-aspectual and multi-dimensional nature of academic achievement dictates a multiplicity of evaluation criteria, which vary across a broad spectrum of indicators ranging from objective/quantitative metrics (grade point average (GPA) (Anwar, Hanurawan, Chusniyah, Setiyowati and Rehman, 2024), marks and overall grade, credit-rating systems, the correctness of test completion, and the accuracy of problem-solving (Fréchette-Simard, Plante, Duchesne, and Chaffee, 2022), response accuracy rates (Guterman, 2021) to subjective/qualitative measures: engagement in the learning process, effective time management (Lewis and Yates, 2019); persistence and resilience in achieving learning objectives (Martin et al., 2022), adaptability, and self-regulation (Anwar et al., 2024).

One of the most crucial aspects of studying academic achievement is identifying the factors and predictors that determine it. Analysis of various studies within this problem area has shown that, provisionally, these factors influencing academic success can be categorised as: personal/non-cognitive (self-efficacy (Willems, Daal, Petegem, Coertjens, and Donche, 2021), confidence, psychological capital, academic coping (Kırıkkanat and Soyer, 2018), communication skills and student engagement (Anwar et al., 2024; Chan, and Dai, 2023), motivation and self-esteem (Petukhova, 2019), anxiety (Bagandova, Ibragimova and Shamkhalova, 2018), etc.); educational (related to the assignments themselves, their complexity, strategy (Freiberg-Hoffmann, Romero-Medina, Ledesma and Fernández-Liporace, 2022). and learning model (Aydin and Demirer, 2022), etc.); social (systems of rewards and incentives for students' academic achievements (Widiarini, Supriyanto and Sunandar, 2023; Swanson and Cole, 2022) and cognitive.

The primary focus of this study is on general and specific (Dvoynin and Trotskaya, 2022) cognitive abilities. Examining research on general cognitive abilities as determinants of academic success and performance yields a wealth of empirical data concerning: the influence of general/psychometric intelligence (Bezerra, Alves, and Azoni, 2022), intellectual activity (Hülür, Gasimova, Robitzsch and Wilhelm, 2018).; fluid intelligence (including non-verbal fluid intelligence), which influences the manifestation of creativity under the mediating influence of field independence (Bouchefra et al., 2022; Giancola, Palmiero and D'Amico, 2022); intellectual flexibility, determining the effectiveness of task completion across varying levels of difficulty and future life goals Ratu, Rai, and Savitri, (2021). It has also been found that cognitive style and epistemological stance (Kholodnaya, 2024), and critical thinking correlate directly with academic self-assessment and learning outcomes (Mafarja and Zulnaidi, 2022). It is noted that a high level of development of cognitive abilities and a strong need for cognition foster intrinsic motivation and engagement in learning, as well as promoting academic achievement (Lavrijsen, Preckel, Verachtert, Vansteenkiste and Verschueren, 2021).

The influence of specific cognitive abilities (such as working memory, information processing speed, phonological awareness, the capacity to establish logical connections, and the ability to distinguish between essential and non-essential information) on academic achievement is also indisputable, finding empirical support in contemporary research (Dvoynin and Trotskaya, 2022; Postavnev, Postavneva, Dvoynin and Romanova, 2020; Tikhomirova, Malykh and Malykh, 2020).

It can be asserted that academic achievement is underpinned by an integrated intellectual-personal resource, wherein cognitive capabilities, the cognitive resource of the individual, become central. The cognitive resource serves as an individual means of integrating diverse forms of subjective experience at both the conceptual and reflective levels. It constitutes a multitude of cognitive elements that are synchronously employed by an individual during the processing of complex information and which facilitate the creation of multi-dimensional models of understanding, including the comprehension of humour at varying levels of complexity. Within this context, the capacity for humour comprehension can be regarded as an

integral component of the cognitive resource (Martin, 2007; Nomura and Maruno, 2011). It can be stated that understanding humour requires an individual to actively utilise and integrate a variety of cognitive functions: analysing information, creativity, identifying semantic relationships, formulating hypotheses, evaluating situations, and much more. Therefore, we shall examine the connection between humour comprehension and specific (most pertinent in this aspect) cognitive abilities.

It has been demonstrated that the level of cognitive development plays a crucial role in the evaluation of humour: for instance, the capacity to identify and resolve incongruities within perceived information is a key component in humour appreciation [39]. A linear relationship between humour and creativity has been identified: the higher the indices of creative thinking and creativity, the more highly developed the sense of humour in individuals (Perchtold-Stefan et al., 2020).

One of the leading predictors of humour comprehension is social intelligence in general, and emotional intelligence in particular: a high level of these determines a well-developed sense of humour, the ability to recognise it, and to react appropriately to jokes (Belesova and Nabi, 2020). It has been found that emotional intelligence positively correlates with adaptive humour styles and is a predictor of both affiliative and self-enhancing humour styles (Ogurlu, 2015). The highest significance is found in the interrelationship between humour and such variables of emotional intelligence as the utilisation and regulation of emotions (Sun, Chen and Jiang, 2017).

In certain studies, it is noted that cognitive styles (information processing styles) significantly influence preferences and the use of humour. Cognitive diversity and flexibility are associated with adaptive humour styles (Yağan and Kaya, 2024), whereas cognitive biases are associated with maladaptive humour. Humour can serve as a defensive/coping strategy, helping people to manage stress and adapt to complex, ambiguous situations (Kondrashikhina, 2021). Intuitive and reflective thinking (as defined by D. Kahneman) serves as predictors of humour perception; however, reflective thinking is more closely linked to humour-related cognition (Ventis, 2015).

Individuals with an open epistemological stance generally possess a greater capacity for humour. It can be asserted that a higher level of openness to experience leads to a greater capacity to generate a humorous perspective on a situation, with cognitive flexibility (to a greater extent) and tolerance for ambiguity (to a lesser extent) playing a key role in this process (Sun, Shen, Lin, Zhang, and Li, 2024). Openness to an epistemological stance encompasses curiosity and a desire for novel experiences, which may foster a more tolerant and humorous outlook on life (Ng, Lin, Marsh, Chan and Ramsay, 2021). Openness to an epistemological stance not only enhances cognitive flexibility and tolerance but also promotes the development of wisdom, which in turn contributes to the development of humour (Leeman, Knight and Fein 2022).

Thus, it can be concluded that humour comprehension is a complex cognitive process that extends beyond the mere recognition of the amusing. It encompasses information processing on multiple levels (levels of cognitive and emotional understanding), demanding cognitive flexibility, the capacity for abstract thought, and an understanding of social contexts, thereby providing a basis for asserting its unique role in the structure of cognitive resources. This role lies in the fact that humour comprehension functions as an integrative indicator of cognitive and emotional abilities.

It should be noted that the potential benefit of humour's influence on learning and academic success depends on a synergistic combination of the appropriate and methodologically sound use of humour by the instructor, and the student's cognitive readiness to perceive and interpret such influence. The student's ability to interpret and evaluate humour is of considerable importance and necessitates a certain level of cognitive development and background knowledge. In such instances, the utilisation of humour in education can improve the emotional state, motivation, and learning outcomes of students, while also stimulating creative and logical thinking (Gel'man, 2021). Humour related to the learning process can enhance the efficiency of cognitive processing, assisting students in better memorising and understanding learning material, and significantly improve students' behavioural accuracy (Erdoğdu and Çakıroğlu, 2021). Humour can contribute to the development of mental agility and student motivation, which favourably influences academic achievement (Oshima, 2018).

Despite a substantial body of research demonstrating the positive influence of humour on the effectiveness and success of learning, there exists data indicating the ambiguity of such influence, and refuting the assertion that the capacity to comprehend humour can be a predictor of academic success. In some instances, humour can negatively affect students and diminish their performance and cognitive perception, particularly when the humour is unrelated to academic workloads (Bolkan, Griffin and Good-

boy, 2018). It is also noted that humorous elements in learning materials, discussions, and assignments do not necessarily contribute to successful test performance (Erdoğdu and Çakıroğlu, 2021). It can be hypothesised that in all these instances, an effect of dissonance was observed between the use of humour in the educational process and the students' abilities to comprehend/perceive it, leading to a negative correlation between humour and academic achievement.

Thus, the theoretical analysis has highlighted the problematic areas of the research:

The identified problems have defined the research objective: to examine the understanding of humour as an element of the cognitive resources of students with varying degrees of academic success. It becomes theoretically justified to study the interrelationships between conceptual, metacognitive, stylistic, and creative characteristics, as well as the understanding of humour by students, as variables of cognitive resources that determine academic success. We hypothesised that a well-developed cognitive resource, incorporating the understanding and evaluation of humour, enables students not only to perceive humorous elements of learning but also to utilise them as a catalyst for more effective and profound assimilation of learning material, which ultimately contributes to academic success. Thus, the following research hypotheses were formulated:

1. Students with high academic success are characterised by well-developed abilities to evaluate and comprehend humour in various forms of witty expression, and an ease of restructuring verbal material.
2. The indicator of humour comprehension will be included in the crystallising factor of the cognitive resource structure of students with high academic success.
3. Complex and multi-dimensional interrelationships exist between the conceptual, stylistic, creative, and metacognitive characteristics of students with varying degrees of academic success, one characteristic of which is their incomplete structure.

Materials and Methods

To investigate the role of humour comprehension within the cognitive resource structure of academically successful students, we conducted an empirical study. The study design can be characterised as deductive-correlational, employing both quantitative and qualitative methods for data processing and interpretation. Specifically, we used comparative analysis (a cross-sectional approach) and statistical tests (Kruskal-Wallis H test, Fisher's φ* transformation, and Pearson's χ^2 test) to identify differences between groups. Factor analysis was employed to determine the structural relationships between humour comprehension and elements of the cognitive resource in students from different groups. The processing of diagnostic results using factor analysis was conducted via principal component analysis to identify the characteristics that significantly explain the nature of these interrelationships (IBM SPSS Statistics Subscription Trial).

The study involved students from Russian universities. The total sample size was N = 325, with participants aged between 18 and 20 years. This comprised 135 male students (41.54%) and 190 female students (58.46%). The mean age was M = 19.49, with a standard deviation of SD (σ) = 1.68, a variance of D (σ^2) = 2.83, and an effect size (Cohen's d) of d_{emp} = 0.01.

Data collection for the implementation of research methods and techniques was carried out through direct interaction with students, using structured and printed stimulus materials. All students participated in the study on a voluntary and non-compensated basis.

To determine academic success (defined as the grade point average (GPA) for the most recent semester), we used official grade reports from the universities' grading systems (serving as objective measures of academic performance), along with a questionnaire (designed to collect biographical data on the students) and students' self-reports regarding their academic performance. The inclusion of both objective indicators of academic performance and students' subjective perceptions of their own achievements allowed for a more complete and accurate representation of academic success.

To examine and assess humour comprehension in various types of witty statements, semantic, categorical, and conceptual abilities, we employed the "Humorous Phrases Test" (A.G. Shmelev and V.S. Babina). The test's stimulus material includes 100 humorous phrases, 40 of which are unambiguous and relate to specific themes (there are 10), and 60 of which are ambiguous. The unambiguous phrases, categorised by theme, assess the degree of accurate understanding of each theme. Increased motivational significance (dominance) of a theme leads respondents to more frequently associate both unambiguous

and ambiguous phrases with that theme, thereby reducing the perceived significance of other themes. Cronbach's alpha for the scales of this test was 0.80, indicating acceptable reliability and internal consistency.

Emotional intelligence was assessed using the N. Hall Test. This test comprises scales measuring emotional awareness, understanding of one's own emotions and the emotions of others, the ability to manage emotions, empathy, self-motivation, and overall emotional intelligence. Cronbach's alpha for the scales of this test was 0.81, indicating acceptable reliability and internal consistency.

The "Ideal Computer" method (M.A. Kholodnaya) was used to examine the cognitive ability of "cognitive stance." The degree of openness of the cognitive stance is determined by the predominance of objectified and categorical questions, while the degree of closedness is determined by subjectivised and factual questions. Cronbach's alpha for the scales of this method was 0.81.

To assess generalised representations of one's own cognitive process organisation techniques and cognitive strategies aimed at transforming the cognitive situation, the "Cognitive Styles of Human Individuality" (CSHI) test (V.M. Rusalov and E.V. Volkova) was used. This test allows for the identification of six pairs of cognitive style characteristics. Cronbach's alpha for the scales of this test was 0.83.

To determine the level of divergent (creative) abilities within the structure of cognitive abilities, the "Torrance Tests of Creative Thinking" (TTCT) (Subtest 2: Figure Completion) was used. This test includes six scales: fluency, originality, elaboration, resistance to premature closure, abstractness of titles, and overall creativity. Cronbach's alpha for the scales of this test was 0.80.

Results

In the first phase of the study, 325 individuals participated and were divided into three groups based on their objective academic performance (high, medium, and low). Subsequently, the students' self-assessments of their academic performance were examined within each group. The majority of students (92.30%) assessed their academic success relatively objectively, accurately reporting their average grade for the most recent semester and the current academic year, as well as their engagement in the learning process. Following the exclusion of incomplete or invalid protocols, the final sample comprised 300 individuals, and students were then differentiated based on academic success. This resulted in the identification of three groups of respondents with homogeneous (consistent across objective and subjective assessments) indicators of academic success: Group 1, high academic achievers (HAA) (85–100 points) – 58 individuals (19.03%); Group 2, medium academic achievers (MAA) (71–84 points) – 152 individuals (51%); and Group 3, low academic achievers (LAA) (≤ 70 points) – 90 individuals (29.97%). The degree of engagement, measured on a 10-point scale, was as follows for each group: high achievers – 9.43 points, medium achievers – 7.84 points, and low achievers – 7.11 points.

The analysis of students' humour comprehension regarding various types of witty statements was conducted based on three indicators: "answer congruence" (emphasising the agreement of student responses with the standard thematic classification of humorous phrases); "incongruence"; and "partial congruence" (Table 1).

Table 1. *Humour Comprehension Scores of Students with Varying Levels of Academic Success*

Groups	The proposed answers, in accordance with the standard themes of the Humorous Phrases Test, were categorised into these three groups and are presented as percentages (%):		
	congruent	incongruent	partially congruent
1. HAA	74,33	23,68	2,02
2. MAA	60,21	38,58	1,21
3. LAA	43,67	56,33	0,00

* The table uses and continues to use abbreviations for groups with high, average and low academic success: respectively – HAA, MAA, LAA

Students in Group 1 (HAA) demonstrated a significantly higher level of congruence (approximately 74.33%) with both unambiguous and ambiguous phrases when comprehending and interpreting humorous phrases, with minimal partial congruence (2.02%). This indicates their highly developed abilities in

humour comprehension and in activating semantic concepts (corresponding to specific words/phrases) as ideas, propositions, and standard thematic labels through cognitive abilities. Students in Groups 2 (MAA) – 38.58% – and 3 (LAA) – 56.33% – demonstrated a high degree of incongruence with the standard themes, reflecting their greater difficulty in recognising jokes/humorous phrases and potentially indicating an insufficient development of cognitive skills that facilitate humour interpretation. Comparative analysis of the results indicated significant differences between the groups both in the number of congruences (H_{emp} = 7.45, p ≤ 0.01) and incongruences in humour comprehension (H_{emp} = 8.21, p ≤ 0.01), reflecting the specific nature of the development of conceptual abilities in students with varying levels of academic success. Significant differences were found between the results of Group 1 compared to Group 2 (φ^*_{emp} = 2.27, p ≤ 0.05) and Group 3 (φ^*_{emp} = 4.82, p ≤ 0.01). Accordingly, the highest level of humour comprehension and ease of restructuring verbal material are characteristic of students with high academic success, supporting the first hypothesis of the study.

The observed differences in humour comprehension necessitated the identification of specific cognitive profiles characterising students with different levels of academic success (Table 2).

Table 2. *Statistical Differences in Cognitive Resource Indicators Among Students with Varying Levels of Academic Success*

Variable	Average values of indicators in groups			Hэмп.=	p≤
	1 (HAA)	2 (MAA)	3 (LAA)		
Cognitive styles of human personality					
Field dependence	12,47	12,36	12,44	6,01	0.05
Field independence	14,47	12,36	12,44	6,01	0.05
Narrow range of equivalence	15,47	16,24	19,56	10,42	0.01
Flexibility	16,54	16,39	18,89	6,49	0.03
Tolerance	18,76	18,27	21,33	7,45	0.02
Emotional intelligence indicators					
Self-motivation	9,29	8,09	13,44	8,47	0.01
Empathy	7,58	6,82	12,22	8,88	0.01
Recognition of emotions in other people	6,88	5,06	11,22	8,22	0.02
General level of emotional intelligence	6,71	3,30	7,09	11,34	0.00
Development	6,88	5,06	11,22	8,22	0.01
Indicators of cognitive position					
Objectivity	92,52	89,23	27.89	24,24	0.00
Subjectivity	7,48	10,77	72.11	17,82	0.00
Categoriality	88,85	33,56	19.53	59,81	0.00
Factuality	11,15	66,44	79.47	58,34	0.00
Cognitive position	Open	Undefined	Closed		

Analysis of the results revealed that students with HAA are distinguished by their ability to approach analysed information in an original manner, objectively identifying its key elements. This likely enables them to understand humorous situations even with some limitations in emotional intelligence (average level of development). Furthermore, these students are characterised by openness to new experiences and high (as in Groups 2 and 3) tolerance for ambiguity, providing a potential platform for cognitive development. Notably, their individual intellectual outlook is characterised by an open cognitive stance (objectification of 92.52% and categorisation of 88.85% of information, with minimal factual orientation – 11.15%), which is significantly higher in categorisation than in Group MAA (φ^*_{emp} = 8.743, p ≤ 0.01) and Group LAA (φ^*_{emp} = 10.27, p ≤ 0.01), and also significantly higher in objectification (φ^*_{emp} = 8.74, p ≤ 0.01) compared to Group LAA. This characteristic makes them flexible and receptive to new ideas and to humour. Compared to Group MAA, students in Group HAA are distinguished by (χ^2_{emp} = 825.13, χ^2_{crit} = 129.97, p ≤ 0.01) the development of symbolic, visual, and sensorimotor-emotional methods of encoding information. Students in all groups exhibited average scores in creative thinking. More highly developed field independence (χ^2_{emp}

= 121.34, χ^2_{crit} = 118.75, $p \leq 0.05$), abstract conceptualisation, and reflectivity in this group (HAA) enable students to form independent yet connected interpretations, allowing them to recognise hidden aspects of information, which is important for the adequate perception of humorous allusions.

In Group MAA, emotional intelligence is below average, and a less developed ability to manage emotions was identified compared to Group HAA (χ^2_{emp} = 82.13, χ^2_{crit} = 12.97, $p \leq 0.01$). They are characterised by an ambiguous cognitive stance, representing an intermediate position between the open cognitive stance (in Group HAA, φ^*_{emp} = 8.74, $p \leq 0.01$) and the closed cognitive stance (in Group LAA, φ^*_{emp} = 2.1, $p \leq 0.05$). It can be hypothesised that this ambiguous cognitive stance may partially function as a metacognitive factor, somewhat compensating for the less developed emotional intelligence and other cognitive characteristics, which consequently allows for a degree of adequate recognition and comprehension of humour, albeit not fully developed. Field independence, flexibility, and abstract thinking form a distinctive cognitive framework in this group. This suggests that these students likely rely on cognitive strategies in the process of processing and understanding humour. Thus, this group exhibits a degree of productive cognitive and metacognitive compensation for emotional underpinnings in humour comprehension.

In Group LAA, an average integrated score for emotional intelligence was found (with some limitations in its constituent elements) – significantly higher compared to the scores of Group MAA (φ^*_{emp} = 2.1, $p \leq 0.05$), reflecting an orientation towards external social cues when solving problems. They are characterised by a concrete conceptualisation style (intolerance of ambiguity, stereotyped solutions, situational behaviour, insufficient integration of concepts, limited differentiation) (χ^2_{emp} = 49.80, χ^2_{crit} = 31.62, $p \leq 0.05$). In other words, despite an average level of emotional intelligence, unproductive stylistic abilities are pronounced. Furthermore, a significant indicator for this group is a closed cognitive stance (φ^*_{emp} = 2.1, $p \leq 0.05$), representing a type of cognitive attitude where students struggle to propose their own ways of making sense of information and do not always adequately perceive unusual information, including humour. However, cognitive flexibility (χ^2_{emp} = 121.34, χ^2_{crit} = 118.75, $p \leq 0.05$) and tolerance of ambiguity (χ^2_{emp} = 123.37, χ^2_{crit} = 118.75, $p \leq 0.05$) represent a certain potential for these students. Thus, the cognitive resource of this group reflects a contradictory pattern: the presence of productive potential in understanding information (including humour), which nevertheless remains underutilised due to the closed cognitive stance.

In summary, the obtained results (considering both significant differences and the absence thereof) reflect the varying effects and specific characteristics of the interrelationships between cognitive resource components and humour comprehension in students. Therefore, in the next phase of the study, a factor analysis was conducted within each group, employing Varimax rotation with Kaiser normalisation. This technique aims to produce a factor loading matrix in which the factors are maximally distinct from each other, facilitating straightforward interpretation.

In Group 1 (HAA), the total variance explained by the factor structure was 79.64%. The factorisation results were significant. The rotated component matrix of the factor structure consisted of 11 factors. The structure was unstable. Three variables were excluded: field dependence, concrete conceptualisation, and the “originality” scale (uniqueness/originality of ideas). In Group 2 (MAA), the total variance explained by the factor structure was 81.02%. The rotated component matrix of the factor structure consisted of 10 factors, it was incomplete and unstable. Three variables were excluded: field dependence, narrow range of equivalence, and intolerance of new experiences. In Group 3 (LAA), the total variance explained by the factor structure was 95%. The rotated component matrix of the factor structure consisted of 8 factors; the structure was complete but unstable.

We will now present a truncated version of the three most significant factors from each structure (Table 3).

Table 3. *Summarised Results of the Three Leading Factors in Groups with Varying Levels of Academic Success*

	Leading factors (1, 2, 3) of rotated component matrices									
		1 (HAA)			2 (MAA)			3 (LAA)		
№	Variable	1	2	3	1	2	3	1	2	3
1	Match with unambiguous phrases of standard topics	**0,85***	-0,11	-0,04	-0,04	**0,95***	0,06	-0,29	-0,08	-0,04
2	Mismatch with unambiguous phrases of standard topics	0,03	**0,87***	-0,03	0,01	**-0,95***	-0,06	0,29	0,08	0,04
3	Partial match with unambiguous phrases of standard topics	**0,84***	0,13	0,14	0,12	0,03	-0,01	0,34	0,25	0,01
4	Field dependence	-0.17	0,23	-0,00	-0,08	-0,38	0,02	0,28	0,45	**0,62***
5	Field independence	**0,60***	0,07	-0,18	0,74*	0,14	0,20	0,48	0,19	-0,02
6	Narrow range of equivalence	0.43	0,25	-0,06	0,43	0,02	-0,03	**0,75***	0,58	-0,03
7	Wide range of equivalence	0.34	-0,05	-0,17	0,25	0,19	-0,02	0,43	0,16	0,21
8	Flexibility	**0,67***	0,32	0,02	**0,73***	-0,07	-0,05	**0,70***	-0,03	-0,07
9	Rigidity	0,04	0,07	0,25	-0,24	-0,25	-0,42	0,05	0,00	**0,93***
10	Impulsivity	0,04	0,08	0,04	0,48	-0,21	-0,36	0,15	-0,03	-0,34
11	Reflexivity	**0,63***	0,11	0,01	-0,01	0,08	0,11	0,17	**0,92***	0,27
12	Concrete conceptualization	0,38	0,28	-0,10	0,03	-0,13	-0,21	0,21	**0,87***	-0,13
13	Abstract conceptualization	**0,78***	0,09	-0,13	**0,78***	0,17	0,23	0,13	**0,85***	0,11
14	Tolerance	**0,76***	0,22	-0,01	**0,79***	0,06	-0,03	-0,06	**0,63***	-0,16
15	Intolerance	-0,11	0,06	0,05	-0,09	0,25	-0,22	**0,54***	0,26	0,42
16	Awareness of own emotions	0,18	**0,69***	0,24	-0,28	0,12	-0,08	**0,89***	0,16	-0,12
17	Management of own emotions	0,14	-0,05	-0,15	**0,57***	-0,27	0,51	0,90*	-0,32	-0,01
18	Self-motivation	0,20	0,35	0,08	**0,68***	-0,15	0,43	**0,87***	0,33	0,00
19	Empathy	0,04	**0,90***	-0,02	0,21	-0,10	0,26	-0,02	**0,84***	-0,20
20	Recognition of emotions of other people	0,29	**0,78***	0,10	**0,52***	-0,12	0,26	0,22	**0,61***	-0,27
21	General level of emotional intelligence	**0,82***	0,26	0,06	**0,63***	-0,20	**0,50***	**0,87***	0,33	-0,16
22	Objectivity	-0,01	**0,92***	0,02	0,02	-0,11	0,14	-0,26	-0,35	**0,86***
23	Subjectivity	0,01	-0,02	-0,02	-0.02	0,11	-0,14	-0,05	0,47	0,00
24	Categoriality	-0,09	**0,93***	0,13	0,16	0,14	**0,88***	-0,31	0,04	**0,63***
25	Facticity	0,09	-0,13	**-0,93***	-0,16	-0,14	**-0.87***	-0,02	0,20	0,16
26	Fluency	-0,23	-0,14	**-0,50***	-0,37	0,17	-0,13	0,21	-0,18	-0,28
27	Originality	0,21	0,19	-0,33	0,07	**0,75***	0,01	0,09	-0,12	-0,12
28	Elaboration	0,02	-0,01	0,08	-0,13	**0,70***	0,05	0,18	-0,00	-0,60
29	Resistance to closure	0,04	0,10	-0,13	0,13	**0,50***	-0,00	-0,56	0,06	-0,28
30	Abstractness of names	**0,53***	0,10	-0,02	0,07	**0,84***	0,08	-0,59	-0,03	0,05
31	General level of creativity	0,38	0,14	-0,14	0,07	**0,92***	0,04	-0,36	-0,03	-0,28

[a] Factor extraction method: principal component analysis.
Rotation method: Varimax with Kaiser normalization.
Note: variables with the highest weight included in the crystallizing factor are highlighted in bold and an asterisk (*).

The obtained effects are clarified through an analysis of the content of the crystallising (first three, most significant) factors.

In Group 1 (HAA), the first factor (Component 1) included nine variables. The analysis revealed that humour comprehension variables have a direct interrelationship with a range of cognitive and creative characteristics: field independence, flexibility, reflectivity, abstract conceptualisation, overall emotional intelligence, tolerance for unrealistic experiences, and abstractness of titles. Accordingly, the develop-

ment of one variable will promote the development of others, suggesting the possibility of improving independent decision-making skills, cognitive flexibility, and the ability to reflect, which may influence creative perception. This result supports the second hypothesis of the study. The second factor (Component 2) includes six variables and reflects indicators of a sufficient level of awareness of one's own emotions, understanding, and managing the emotions of other people. The third factor (Component 3) included two variables with inverse relationships: factual questions and fluency of idea generation. This interrelationship indicates that the speed of humour comprehension in students may decrease due to a decrease in the speed of idea generation. At the same time, a decreased emphasis on factual information contributes to an increase in the quality of humour comprehension. Thus, indicators of humour comprehension, in interrelationship with a range of cognitive characteristics, are included in the crystallising factor of the cognitive resource structure of students with high academic success.

In Group 2 (MAA), Factor 1 (Component 1) included eight variables. Their content reflects indicators of the integration of metacognitive and emotional resources of students in the information processing. Indicators of humour comprehension (congruence with unambiguous phrases from standard themes and the inverse of incongruence with unambiguous phrases from standard themes), in interrelationship with originality, elaboration, abstractness of titles, and overall creativity, are included in the second (substantial) factor of the cognitive resource structure of students with medium academic success. The content of this factor represents a creative resource (differentiated and independent) as a potential for working with information in situations of uncertainty. Factor 3 (Component 3) included two variables: categorical and factual questions, which have an inverse relationship with each other. This inverse relationship is theoretically driven and is a sign of an ambiguous cognitive stance. The factor structure in this group is distinguished by partial integration of metacognitive, creative, and intellectual characteristics, as well as signs of contradiction (on the one hand, the ability to resist stereotyped thinking in creativity, and on the other hand – signs of an ambiguous cognitive stance).

In Group 3 (LAA), the first factor included seven variables that have a direct interrelationship. The content of the factor reflects a constellation of characteristics of emotional intelligence in interrelationship with indicators of a lack of metacognitive resource due to inversions found in the results. Factor 2 (Component 2) comprised six variables, reflecting a direct relationship between metacognitive and intellectual characteristics, even when employing information processing styles that may differ in their productivity. The third factor encompassed four variables: field dependence, rigidity, objectified and categorical questions. The interrelation of these variables points to a pronounced internal contradiction within the component structure concerning indicators of cognitive maturity. The measure of humour comprehension (agreement with unambiguous phrases on standard themes), in conjunction with objectification, categorisation, and rigidity, was only incorporated into the third (less salient) factor of the cognitive resource structure of students with low academic achievement.

Therefore, the results of the factor analysis support the third hypothesis, revealing diverse associations between cognitive, stylistic, and metacognitive characteristics within the factor structures of different student groups.

Discussions

During the empirical study, three groups of students were identified, representing varying levels (high, medium, and low) of academic achievement and corresponding self-assessments of their own academic success. It was found that students in Group 1 (High Academic Achievement - HAA) demonstrated the best performance in humour comprehension, while students in Group 2 (Medium Academic Achievement - MAA) and especially Group 3 (Low Academic Achievement - LAA) exhibited a relatively low level of humour comprehension. Substantive analysis of the cognitive resource of students with different academic achievement indicated that students in all groups require the development of stylistic and creative qualities, albeit with group-specific characteristics.

Students with high academic achievement and the highest scores in humour comprehension possess an ease in restructuring verbal gestalts and an ability to overcome existing conceptual structures and form new semantic structures. However, they exhibit insufficiently developed abilities in managing and recognising emotional states, which partially diminishes their cognitive capabilities. Provisionally, these students can be described as intellectually flexible with productive humour comprehension, against

a backdrop of reduced speed in idea generation. These results partially align with the findings of several contemporary studies (Kholodnaya, 2024; Shcherbakova, 2009; Kocak, 2018). It can be concluded that the cognitive profile identified in this group contributes to students' academic achievements.

Students with medium academic achievement and humour comprehension are characterised by the fact that the process of restructuring verbal gestalts and forming new semantic structures may present them with some difficulties. Nevertheless, they are characterised by productive metacognitive compensation for emotional misunderstanding and indications of integration with characteristics of humour comprehension. They can be defined as strategists with productive compensation of comic comprehension. This definition is supported by the research of Shcherbakova (2009), who notes that the understanding of a comic text requires the presence of an individual integrated system of emotional resource, cognitive resource of understanding, metacognitive control in the process of emotional attachment to the context and cognitive restructuring (Shcherbakova, 2009).

Students with low academic achievement and the lowest scores in humour comprehension are characterised by a pronounced inconsistency in their results. Despite possessing productive potential (the highest level of emotional intelligence among the groups), they exhibit a marked inability to utilise it (difficulties in restructuring verbal gestalts, a low capacity to overcome existing conceptual structures and form new semantic structures). Provisionally, they can be designated as individuals with an inverted resource effect in humour comprehension. These results point to an inversion of outcomes as a novel scientific finding in the context of studying cognitive humour comprehension in students.

During the identification of interrelationships between students' cognitive characteristics, factor structures were obtained that differed in content, reflecting the potential for integrating various resources (creative, metacognitive, and stylistic) when interacting with humour. It was found that cognitive and creative variables (flexibility, field independence, and abstract thinking) serve as key determinants of the ability to effectively perceive and interpret humour. This profile (identified in students with high academic achievement) facilitates not only a creative and independent perception of complex humorous contexts but also high academic achievements. These results correlate with studies emphasising the role of creativity (Perchtold-Stefan et al., 2020) and cognitive styles in humour comprehension. In particular, the ability to think analytically, recognise incongruity (corresponding to the cognitive styles of field independence and abstract thinking) allows for more effective processing of complex information contained in humorous texts and its integration into the existing knowledge system (Canestrari, Dionigi and Zuczkowski, 2014), thereby enhancing the learning process.

For students with medium academic achievement, a complex structure of cognitive variables is characteristic within the crystallising factor (field independence, flexibility of cognitive control, abstract conceptualisation, tolerance of uncertainty, emotional management, self-motivation, the ability to influence the emotional state of others, an integrative level of emotional intelligence). This suggests that a low level of abilities in managing and recognising emotions can be compensated for by cognitive strategies and self-motivation, allowing for analysis and interpretation of humour at a medium level of effectiveness. This aligns with the compensatory effort model, in which individuals with limited resources can utilise other cognitive strategies to achieve desired outcomes (Traut, Guild and Munakata, 2021).

The contradictory factor structure identified in students with low academic achievement (the presence of high potential in the realm of emotional intelligence and the capacity for cognitive adaptability, against a backdrop of structural limitations and stereotypical patterns of thinking) hinders productive humour comprehension. The existing potential for understanding information remains untapped due to a closed cognitive stance and a deficit in the skills of emotional management and adaptation to illogical experiences, which also leads to a significant reduction in academic success. These data corroborate research noting that potential cognitive resources remain unexploited due to the absence of conducive conditions for their manifestation and development (De Jonge and Huter, 2021; Tricot et al., 2020). Accordingly, the mediated development of cognitive humour comprehension within the learning process for these students may create opportunities for them to more readily assimilate complex academic tasks.

Conclusions

The results of the empirical study demonstrate a complex and multifaceted relationship between cognitive styles, emotional intelligence, and the capacity for humour comprehension in students with varying levels of academic achievement. Based on the specific results obtained across all groups, one can

posit the existence of distinct cognitive and emotional 'profiles' that determine success in humour comprehension. An open cognitive stance, well-developed information encoding styles, and abstract thinking appear to be the most effective strategies, while a closed cognitive stance and a rigid thinking style impede adequate perception of humorous stimuli. These data underscore the importance of considering individual cognitive and emotional characteristics when developing educational strategies aimed at fostering critical thinking, creativity, and the ability to understand complex social cues, including humour.

The interrelationships discovered within the factor structures reflect the potential for integrating conceptual, stylistic, creative, and metacognitive characteristics of students in relation to humour comprehension, which acquires specificity in groups of students with different academic achievement. Humour comprehension, as one of the variables of the crystallising factor of cognitive resource, contributes to the academic success of students, which aligns with the limited research on this topic (Musiichuk, 2018). At the same time, the identified crystallising factors demonstrate indications of integration not of all the productive variables studied in this regard. Thus, it can be concluded that for successful humour comprehension and the achievement of academic goals, it is necessary not only to have cognitive and emotional resources but also their productive integration, the study of which could become an important direction for further research.

Therefore, a well-developed cognitive resource, including humour comprehension and appreciation, enables the effective use of humorous elements in learning. However, the observed effects manifest with varying degrees of prominence in students with different levels of academic achievement. For students with high scores, humour acts as a catalyst for deep learning, contributing to academic success. Further research is needed to identify the specific mechanisms of humour's influence on students with medium and low scores. It is possible that these groups require methods of using humour in education adapted to their cognitive characteristics, such as a more explicit and straightforward explanation of jokes or the use of humour directly related to the material being studied. The development of such differentiated techniques will maximise the positive impact of humour on students' academic success.

The advantages of the conducted research lie in a more comprehensive and systematic approach, providing a deep and multidimensional understanding of the complex nature of academic achievement and the cognitive mechanisms that underpin it. Further research should be directed towards studying the mechanisms of interaction between cognitive and emotional factors and their integration in the process of humour comprehension, as well as developing tools for diagnosing and developing the corresponding competencies. For example, the results obtained, especially in the MAA and LAA groups, could become a basis for the development of a psycho-pedagogical training program for students. The main goal of such training could be to develop cognitive strategies in students during the processing of humorous stimuli. This could form the foundation for creating and optimising innovative approaches to the educational process and developing the cognitive potential of students.

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Conflict of interests

The authors declare no conflict of interest.

Author Contributions

Conceptualization, Kibalchenko Irina, Eksakusto Tatiana; formal analysis, Kibalchenko Irina, Eksakusto Tatiana; Data curation, Kibalchenko Irina; methodology, Kibalchenko Irina; writing - original draft preparation, Eksakusto Tatiana; writing - review and editing, Eksakusto Tatiana. All authors have read and agreed to the published version of the manuscript.

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